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Between resistance and resilience: a study of flood risk management in the Don catchment area (UK)

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The river Don catchment area in Sheffield and Rotherham offers a good place for a case study of flood risk management, given the impact of a flooding event in 2007 and the way in which local events have become entwined with national and international policy shifts. To interpret local policy, a combination of systems based and socio-cultural theory is used. Both the theories and the case study serve to disentangle the multiple meanings of resilience. Understood in opposition to flood resistance, resilience has only limited applicability in an area such as the case study where engineering works protect employment and infrastructure. Resilience as a policy discourse also lacks political transparency and a recognition of socio-cultural influences. Underlying the shift towards resilient styles of management is an appreciation of the importance of capacity, to learn and to act. The case study identifies blockages to the realisation of that capacity.

The aim of this paper is to examine flood risk management in England within a multi-theoretical framework applied to the river Don and its tributaries in Sheffield and Rotherham. Flooding is a recurrent threat in England and flood management is a necessary means through which English cities are responding to the prospect of climate change. At the same time, the methods of flood risk management have undergone a welcome change, according to various authors (Hartmann and Driessen, 2013: Liao 2012), as governments in many countries, including the UK, favour flexible, 'resilient', social learning approaches, rather than 'hard' engineering projects.¹ The preparation of this particular case study of flood protection measures, from June 2007 to June 2017, provides a means of assessing the extent and implications of recent policy changes, including the exact meaning of resilience.

The account is divided into three main sections.

Section one 'Systems and social order' is about relevant analytical frameworks, their assumptions and contents.

Section two comprises the case study. It includes an analysis of the problem, a narrative of the policy response in the past ten years

Section three interprets the local policy response in the light of the frameworks.

Systems and social order: conceptualising flood risk management

In the simplest terms, two contrasting analytical frameworks may be identified for flood protection, based respectively on contrasting ontologies- the material

processes of flows, forces, populations and systems, and the social processes of interest group politics and social order (Archer 1996: Lockwood 1964). Given, the existence of hybrid approaches that assume 'coupled systems' between the physical and social worlds (Liu et al 2013), three relevant frameworks may be identified:

- adaptive management, based on turbulent, ecological systems (Gunderson et al 2002):
- transition management, based on measures to change established socio technical (or human dominated) systems (Ernstson et al 2010):
- the management of expectations based on the social construction of risk (Hartmann 2012).

Adaptive management

To discuss each approach in turn: Theories of adaptive management summarise the assumption of many aspects of contemporary flood management, including resilience. In principle, resilience means the ability of the system to absorb or withstand disturbance (Ingirige and Amaratunga 2013) or in technical language, its ability to cope with 'panarchy', an intermediate situation between chaos and order, the predictable and the unpredictable (Innes and Booher 1999, 22). In addition, panarchy and adaptive flood management imply in principle a preference for 'natural', as this term is used in UK policy debates ² or 'green' flood risk management as used elsewhere (Janssen et al 2015), without heavy engineering works.

There is, however, a subtle shift in attitudes once panarchy is applied to routine flood protection. In ecological systems, flooding is a natural and potentially creative force. . Once transferred to the management of human environments (Davoudi 2014) and applied to property, with all its legal rigidities (Tempels and Hartmann 2014), flooding assumes a negative meaning- as system failure. Moreover, in seeking to avoid system failure, the concept of resilience becomes muddled. The ecological concept of resilience involves adaptation in contrast to resistance, this latter meaning the ability to withstand stresses and shocks without change and without dysfunctional consequences (Norris et al 2008). In policy discourses, however, as for example stated in UK government advice (DEFRA-EA 2010) resilience is likely to encompass specific engineering works intended to ensure that critical infrastructure can withstand extreme events.

Adaptive management is, nevertheless, distinctive in two other ways.

First, the socio-ecological system is assumed to be too large and its behaviour too unpredictable to be engineered as a whole. The management of panarchy involves a search for multiple solutions and multiple measures in a way that favours a process of co-evolution between governmental bodies and other actors, that includes spontaneous responses to events as these occur (Klein et al 1998, 263) and that implies 'community resilience' (Norris et al 2008, as well as ecological resilience).

The latter concept deserves more consideration. Applied to flooding, community resilience means the ability of local communities to organise and protect themselves and recover through property-level improvements and other measures. Whether residents and businesses can and are likely to do so is another question. The take-up of property-level measures is typically low in the absence of determined efforts to encourage uptake (Bhattacharya-Mis et al 2015). To give a specific example, a survey of Cockermouth (Cumbria, England) a small, flood affected town found that despite a huge increase in insurance 'only 11%' of small businesses 'had installed flood resilient wall finishes' ³ Communities and firms vary, in their ability and willingness to act and some will not be able to help themselves without material help, rather than just encouragement.

Second, adaptive management is distinct in the range and number of institutional actors who are affected. In relation to a river floodplain, adaptive management would use the local catchment area as a basis for co-ordinated action and would seek to a public consensus on which to base action and detailed management (Innes & Booher 1999).

Agreeing a co-ordinated, integrated catchment plan is likely to be complex, however. Potential water overspill areas may have very different meanings for locals, experts and managers (Kati and Jari 2016). Public involvement promotes transparency, but is time consuming and, depending on local circumstances, not necessarily of value in finding flexible solutions (Menzel & Buchecker 2013). Further, detailed co-ordination and management may prove cumbersome, as Coulthard and Frostick (2010) have suggested in a case study of Hull (East Yorkshire).

Transition management

The limitations of adaptive management suggest that production and consumption practices need to be changed to cope with long-term risks. Transition management

deals exactly with this second type of factor and second type of system comprising multiple, overlapping networks of actors, supply chains and associated technology, each locked into particular forms of production and consumption practices and so requires some specific event or external 'push' to facilitate change. Change may be stimulated, for example, through any combination of local experiments, in so-called 'niches' or through a concerted policy effort, the so-called 'regime' of public finance and regulation. Whatever the transition pathway, whether from niches or regimes, however, the emphasis is invariably on planned, managed or intended change rather than a spontaneous cycle of destruction and renewal of socio-ecological systems.

As presented by its main advocates (Geels 2005: 11: Kemp et al 2007: Loorbach 2010), transition management involves a multiple, multi-level passage from one state of a socio-technical system to another, with the state after transition representing a higher level of achievement on a variety of sustainability criteria-energy use, recycling, pollution, biodiversity and so on. Governments work with producers, in a process of co-evaluation, making products more sustainable and resilient. Co-evolution applied to flood risk management implies a reformulation of the role of local authorities and other public sector actors as an 'honest broker' (Ingirige & Wedawatta 2014) who advises property owners on a range of measures.

Co-evolution suggests, in addition, that regulations such as planning controls, building controls and environmental regulation are merely one element in a panoply of measures that steer and redefine economic behaviour in a sustainable direction. Regulation, including the expectation of future regulation, can promote innovation. However, regulation is only likely to become effective once extensive compliance is already realised through voluntary means. (Kemp et al 2007: Parto 2007). Whether or not transition is fully realised is typically problematic, however. Case studies (Moloney and Horne 2015: Vandevyvere & Nevens 2015) suggest that the various levels often fail to work together; for example local initiatives are not sufficiently supported by national government.

The management of expectations

Personal experience and the perception of that experience mark the concerns of the third approach, dealing with the management of expectations . Expectations and perception are linked to awareness. Moreover, awareness of risk is based ultimately on individual experience, knowledge and memory. However, a single 'collective

memory' is an impossibility (Douglas 2013, 59-60), unless the memories of different individuals are institutionalised into the cultural practices and working practices that cumulatively comprise the established social order.

Conversely, assumptions about social order influence the form and type of institutional arrangement and the style of risk management- as, in other words, an aspect of socio-cultural theory as this approach is also called. Two bases for social order may be distinguished (Douglas 1999)- grid, this comprising a mesh of regulations, as exemplified by a bureaucracy and group, this comprising informal and voluntary alliance of individuals and the associated methods of social control. Equally, the strength of the social order may vary, so resulting in four styles of action, as shown in the left hand column in Table 1, below. Each style makes different assumptions about social organisation and the social assumptions of risk management, including flood management policy.

Table 1

High grid/ high group styles of action cover conventional land use planning and water engineering. They favour spatial order and the management of nature, using a co-ordinated range of policy measures for different areas, places and types of property. In contrast, low grid/ low group styles are about individual resilience, responsiveness and assume that individual organisation and initiative will suffice. Low grid/ high group is about the promotion of supportive communities and therefore community resilience, whether residential communities or informal business groups. The final category, high grid/ low group- isolation and fatalism- might be equated with isolation and hopelessness. In circumstances, where nothing can be done, fatalism may nevertheless be a realistic response.

Grid/ group theory does not offer a system. In the first place, it provides a classification of the varied and 'clumsy' array of perceptions and preferred solutions of different groups and governments (Verweij, Douglas et al 2006), with the modalities of action reflecting the wider political culture, the institutions already in place and their interaction with one another. Grid/ group theory has been applied to flood management by Hartmann (2012), but only in a limited way that treats the different logics of action as an aspect of an over-arching policy, rather than in the original sense of Douglas as a shifting set of partly complementary and partly conflicting institutional principles. Grid-group theory is therefore about the management of expectations only as intent. Because expectations involve cultural

assumptions and conflicting institutional principles, they may be unmanageable either in whole or part.

In addition, the grid/ group framework assumes a dialectic relationship between 'centre' and 'periphery', between hierarchical governmental agencies and non-hierarchical organizations who feel that they are at the 'border', to use the term of Douglas and Wildavsky (1982) of conventional politics. For different reasons, neither bureaucracy nor the market encourages critical thinking or radical change. The periphery, in contrast, is alert to the failures of the centre, is easily alarmed by threats to nature and is able to use local knowledge to generate warnings and solutions. A case study of flood protection by Whatmore (2013) in the small town of Pickering (Yorkshire, England) provides an example. In this case, citizens' action and local knowledge led to an acceptance of small-scale, low impact, upstream flood storage in a way that the technical experts had not previously considered. Contrary to the example in Pickering, however, non-hierarchical organisations and pressure groups do not necessarily favour egalitarian policies, as their membership may be drawn from a narrow social group.

The frameworks together

Taking all this together, the frameworks may be summarised as follows:

Table 2

Adaptive management and transition management are systems approaches concerned with the capacity of governments to manage and reduce risk in the short and long-term in a process of co-evolution with other institutional actors. As such they both assume the existence of a rationalist planning cycle, that involves the separation of means and ends and the use of systematic analytical techniques . (Goodchild 2017, 129-133). The details the planning cycle vary. In adaptive management, the cycle starts from an event such as a disaster and then moves to recovery and longer term strategies, based on the avoidance of similar problems in the future. ⁴ In transition management, the cycle starts with the identification of agreed targets, expressing different aspects of sustainable practice and of 'pathways' to reach those targets (Geels 2005: Goodchild 2017, 226-231; Kemp et al 2007). For both approaches, however, the planning cycles can be conceived as a series of decision making stages that, encourage social learning, including the evaluation of outcomes. Learning and related concepts such as 'capacity'- to

process and evaluate information and to act effectively- are, therefore, a necessary aspect of resilience and in some accounts (Liao 2012: Newman 2011) the defining aspect.

Equally, however, if redefined in terms of learning, the meaning of resilience changes, away from a type of measure to the type of management process. Under the pressure of events, individuals, groups and public authorities learn to anticipate, prevent and cope with events and, in doing so, work out new responses. Put slightly differently, if defined as process the term has no necessary ecological characteristics..

Socio-cultural theory is compatible with a planning cycle that starts with a disaster and also with 'learning' as an individual and institutional process. Douglas (2013, 59) recognises, for example 'the memory of past investigations and precedents' as an influence on the perception of danger. Other than in the highly managed, high grid approach of bureaucracies, however, socio-cultural theory suggests a relatively flexible, pragmatic and sometimes reactive style of learning, without deliberate decision making stages.

The case study

The river Don catchment in Sheffield and Rotherham illustrates many aspects of current approaches to the management of flood risk, especially in an urban area where the risk affects business and employment. It is also a good place for a case study as local events have become entwined with initiatives at an all England and, in some cases European Union (EU) level. Other studies have examined business resilience per se ⁵ and the tension in environmental design between technical expertise and local place attachment (Haughton 2015). The interest here is about the relationship between flood protection, business and urban governance at a strategic, district-wide level.

Methodology and presentation

The underlying methodology is informed by a modified version of the 'phronetic' method of Flyvbjerg (2004: 2006). Phronesis is the Greek word for practical judgement. The phronetic method involves bringing together and, where necessary, contrasting varied information to reveal the interrelations between technical

rationalities and the power of interest groups. This case study brings together and contrasts different sources of information. It is concerned, however with the capacity as well as the power of different actors and, in addition, the extent to which local policy and practice is consistent with the various theoretical frameworks and a shift to resilience.

In this context, the main institutional actors are as follows;

- The local authorities for Sheffield and Rotherham, elected bodies with a wide range of responsibilities for the welfare of the population:
- The Environment Agency, a national agency with regional offices responsible *inter alia* for the coordination of flood protection measures and for directing central government funds into local projects:
- A private water utility company, Yorkshire Water, responsible for the supply of drinking water, sewage disposal and aspects of land drainage and also a major land owner around water courses:
- The two Chambers of Commerce for Sheffield and Rotherham, representing local businesses:
- And finally, a shifting and diverse array of local amenity and environmental groups.

The sources of information come from a combination of statistical sources, policy documents, the web pages of local groups, the archives of the local newspaper, the 'Sheffield Star' and a series of interviews with 15 respondents , undertaken between 2014 and 2016. The respondents covered officers of the local authorities, the Environment Agency and the two Chambers of Commerce as well as six small businesses, located in areas with a known risk of flooding. Fifteen businesses were contacted but full interviews could only be secured with three. A further three businesses supplied information over the telephone. All the interviews were semi-structured, with a schedule of questions specified in advance. The officers were asked about the role, activities and plans of their organisation, as well as their experience over the past few years, especially when working with businesses and their perception of the main policy issues. The businesses were asked about the number of jobs at risk, their experience of flooding and their plans to cope with any future event.

The intention throughout was to generate a narrative showing the interaction between events, analyses and the response of institutional actors. The presentation of

the case study therefore starts with a summary of the problem, before moving to the policy response and then, in a subsequent section, a discussion of the policy response in the light of the theories and previous studies. As such, the narrative is intended to disentangle the chronology of events from its interpretation.

Chronology and interpretation cannot be wholly separated however. The account starts with a sudden event, a flood, followed by exercises in learning and innovation. The structure of the account might therefore suggest implicit support for the existence of a rationalist planning process. Subsequent events have not followed a single planning cycle, however. Different cycles of plan preparation and implementation have operated alongside one another depending on the involvement of different layers of government or different policy fields and initiatives. Financial constraints and the existence of separate financial planning cycles have led to proposals being modified, sometimes at short notice. Further, the response of residents and local amenity groups has mostly arisen once the consultation process has reached place-specific proposals rather at a strategic stage. Yet this response may itself challenge key aspects of a proposal. Actions, measures and decisions may therefore be rational as a pragmatic response to constraints, but not rationalist in the sense of following a prescriptive model of stages of decision making and action.

Characteristics of the problem

On 25 June 2007 extreme rain overwhelmed the drainage system in the Done valley catchment area. In Sheffield, alone, over 1,200 homes were flooded and more than 1,000 businesses were affected (SCC, 2013b, 14), including industries of national importance. Flood waters rose rapidly, catching people unaware and requiring their evacuation from their work place or home. Thousands were left without power and two people died.

The dramatic events of 2007 are not easily forgotten for those directly affected. One respondent working for a local agency had been directly affected by the floods and provided a vivid account:

'From our office window we ... were watching this stream of water at the side of the road that grew to a foot wide in less than three or four minutes and then grew to three foot wide in another five to ten minutes and it was a case of people need to move, we need to let people get out cos it was bad. We used to park across the road, by the time I'd got packed up and we were heading out I got across that road and it was about a foot deep.'

The river Don within Sheffield and Rotherham is ‘little more than a large stream’ in normal conditions (SCC, 2013b, 2), as shown in Figure 1.

Figure 1:

Flooding had not occurred for over forty years previous to 2007 and the earlier event in 1965 involved water levels that were 1 metre lower (SCC, 2013b). The area at risk of flooding is nevertheless considerable, as is shown in Figure 2. Moreover, the risk is exacerbated by the way that the local tributaries are set in relatively steep sided valleys, are mostly culverted in their urbanised sections and respond quickly to rainfall (SCC, 2013c, 13).

Figure 2:

The immediate response took the form of collaborative exercises between the multiple agencies involved in emergency work. In relation to businesses, the local Chambers of Commerce provided the main intermediary and point of contact with the local authorities and other public sector agencies. Businesses were also active in mutual aid, lending equipment to each other and, for smaller businesses, arranging for the use of alternative premises.

Once the short-term recovery problems were mostly resolved, the long-term significance of the 2007 event was to demonstrate the vulnerability of businesses and employment. The Don Valley Catchment Area Plan (EA 2010) provides estimates of the total number of properties at annual risk of fluvial flooding, without however distinguishing between residential and non-residential uses. According to this calculation, about 5,000 properties in Sheffield and a further 800 in Rotherham are at an annual risk of one per cent or more (EA 2010, 9). The numbers are only approximate, as they exclude areas affected by local rainfall events, exclude the impact of any trend towards future weather extremes, whilst including properties sited in at risk areas covered by existing flood defences.

The ESRC Consumer Data Research Centre provides an alternative, mappable means of estimating the number of residential and non-residential properties at risk of flooding, with the number of non-residential properties indicated below.

Table 3

Non-residential includes public buildings, but may be taken as a proxy for businesses. The total number of residential and non-residential properties at risk is less in Rotherham than in Sheffield. However, Rotherham includes a concentration of non-residential properties at high risk mostly located in and near the town centre.

Figure 3 shows the relevant pattern using a kernel density mapping technique (Silverman, 1986).

Figure 3:

There is no directly available public dataset that gives employment figures for small-scale areas. The Workday Population Census (2011) data at output level may be used to give an approximate number. The minimum output area (OA) is 40 resident households and 100 resident people (The Office of National Statistics, 2012). If we select the number of OA's that intersect with flood risk zone 2 (1 in 1000 year flood) we find that 17.82% of OAs in South Yorkshire are at risk of flooding. This equates to a potential maximum of 52,986 jobs in Sheffield and 28,672 jobs in Rotherham. Estimates based on Census Output Level data are almost certainly overestimates as they include jobs that are outside risk areas.

Flooding on the scale experienced in 2007 also damaged the urban infrastructure- road bridges, railway lines, electricity, water supply and sewage- in a way that affected everyone living and working in the locality. For these reasons, flooding has become explicitly recognised as a risk in the economic regeneration strategies for the wider Sheffield city region (Oxford Economics 2013).

The policy response

The novelty of the flood events of 2007 meant that the various agencies responsible for flood risk management lacked relevant experience. Their response was to undertake a series of risk assessment studies, to seek resources and advice from elsewhere and to co-operate with national government in enquiries that covered similar flooding events elsewhere in England. The result was a huge and very varied amount of policy advice, most notably in two EU initiatives, MARE (Managing Adaptive Responses) (2009-2012) ⁶ and CAMINO (Climate Adaption Mainstreaming through Innovation) (2013-2015) ⁷ and a national policy review, the 'Pitt Review' (2008).

MARE and CAMINO, were intended to promote experimentation, innovation and multi-national learning. Partly for this reason, they included initiatives that subsequently either failed, as in a proposed regional flood management body or for which there is no record of implementation, as in a proposal to promote property level measures through intermediaries such as DIY stores (Annexes 16 and 17). Even if limited in their impact, however, CAMINO and MARE provided additional staff

funding at a time when the resources of the local authorities were tested. Indeed, lack of staffing resources was itself a reason for their lack of impact. For example, in the view of a respondent, a senior local government officer, the regional initiative failed because:

'it was local authority based and ... the difficulties that local authorities have been undergoing in recent years.' 'I bet there's not one in five of the people who used to go to that organisation still working for local authorities, it's been savage.'

Once EU funding disappeared, the local authority lost capacity to organise and to act.

The Pitt review (2008) was different. It had a national frame of reference and sought to summarise all relevant policy measures, covering seven main issues: reducing the risk of flooding and its impact; the provision of emergency services; protecting essential services; better advice and help to those affected; speeding up recovery; better prediction in advance. A governmental progress report (DEFRA 2012) stated that, of the report's 92 specific recommendations, 43 had been implemented, 40 were partly implemented and a further nine were subject to further reviews or other complications.

However, the government's assessment overstates the extent of implementation. To give an example: Pitt Review recommendation 12 (2008, xvi) states 'All local authorities should extend eligibility for home improvement grants and loans to include flood resistance and resilience products.' The eligibility of property level grant aid was indeed confirmed by administrative action and was also extended to business properties. However, eligibility is only an initial step. The funds also have to be made available and in many parts of the country, including South Yorkshire, flood resilience work is not a major theme in the small housing improvement programmes currently in force.

The longer term response in Sheffield and Rotherham was undertaken within the framework of the strategic management plans that were another recommendation of the Pitt Review and were undertaken in accordance with a preference for an explicitly coordinated multi-agency 'partnership' (EA 2010). The same approach was also favoured by the MARE project under whose imprint the earliest plans were published.

To take policies in Sheffield and Rotherham in turn: In Sheffield, policy emerged largely through a process of exclusion. The Lower Don Valley and adjacent areas were identified as priority areas, this being 'driven by the need to sustain the

economic and regeneration processes of the area' (SCC, 2013a). Formal defences in the city were few (SCC 2013b, 18) and difficult to finance. The possibility of flood relief spillways was impractical owing to the built-up character of the floodplain (SCC 2013a, 17). Moreover, 'building resilience within the community' was discounted 'as most of the existing buildings in the areas considered could not easily be adapted to withstand flooding.' (SCC 2013b, 9).

Despite references to community involvement, the initial style of decision making was led by experts (consultants and officials). Where consultation took place, with emphasis was on protecting business. At the same time, the cost of increased flood protection could not easily be justified under the funding formulas then in force. Instead, the local authority approached the business community to fill the gap through the declaration of a Business Improvement District (BID) for the Lower Don Valley- an area that covers a mixture of small traders near the city centre and a mixture of medium sized and large employers elsewhere.

A BID is a legal mechanism, most commonly used in town and city centres, where businesses vote to pay additional taxes to support local improvements or management. If 50% of businesses and 50% of the total rateable value of businesses support the proposal then additional taxes are levied on all property owners within the BID area over a five year period. In this specific case, a majority of 82% of voters and 95% of those based on rateable value approved the scheme in a ballot, held in December 2013. About 10% of the cost of the works (7% of the continuing budget) came from local business sources, the rest from different central government agencies.⁸

The measures within the BID area have comprised a mixture of strengthening barriers and preventative works such as the clearing of accumulated debris and vegetation from the river channel and the creation of a river monitoring system. The overall aim has been to lower the annual risk of flooding from 1:25 in places to a minimum of 1: 100, so allowing businesses to obtain insurance more easily (EA 2013). The BID has also established a liaison officer in the Chamber of Commerce, managing communications with levy paying businesses and other stakeholder groups. In interview, it emerged that the response of local businesses was mixed, with some being reluctant to become involved and others being more proactive.

Outside the BID area, policies comprise a mixture of protection works river clearance and the provision of sustainable urban drainage and associated amenity

measures (WYG Engineering 2010, 11). The model for the amenity measures became a new 'pocket' park at Nursery Street (Sheffield Star 04/08/2011: 21/09/2012). The park was substantially reduced in its size at the detailed design stage owing to financial constraints. However, as completed in 2012, it still opened up a formerly constrained river channel. Similar schemes have also gone ahead as a nature reserve downstream of the main industrial and commercial area (Blackburn Meadows) ⁹ and as another pocket park along a small tributary (Matilda Street). ¹⁰

Figure 4

In addition the search for more extensive upstream water storage led, during 2016, to proposals to impound flood waters in existing parks at Endcliffe and Millhouses and in amenity woodland elsewhere. ¹¹ The proposals are acknowledged to be 'sensitive' by officials (Sheffield Star, 27/07/2016 and 27/10/2016) and, at the time of the study, were subject to public consultation, the form of which was itself contested. Concerned groups argue that more attention be paid to flood management on agricultural land and through the use of existing water reservoirs. ¹²

Rotherham lies immediately downstream from Sheffield. The strategies for Sheffield are subject to coordination by the Environment Agency at a regional level so that they do not worsen the situation in Rotherham. There are, however, few formal mechanisms for direct coordination between the two local authorities.

The first response in Rotherham, following the clean-up and repair exercises associated with the 2007 floods, comprised the erection of additional walls, piling and another overspill flood area at Templeborough. Otherwise, the policy has been mostly to promote property-level protection and safety measures through a toolkit incorporated into the planning system. The toolkit itself goes into considerable detail about the level of flood risk in different zones, the importance of safety in use, the treatment of surface water run-off and measures to minimise damage through water resistant fittings and materials. ¹³

Other toolkits and sources of advice are available, for example from the Association of British Insurers (2016). However, the use of property-level toolkits is itself of limited value, as became apparent in the interviews. For the local authority, their publication amounted to an admission that it could no longer protect the highest risk areas. Indeed, in one passage, the Rotherham local plan states that 'ideally development should be moved away from these areas' (RMDC 2014, 144). There has been no attempt to implement any such policy, however.

For businesses, the advice given in the toolkits was not a priority, even if they were aware of the contents. In the words of an informant with much experience of local businesses:

'sometimes it can be a hard push They (*the businesses*) are always trading off against other things that are important ... and ... some of these things that are deemed aren't quite as important as others, until something happens. ... People generally do the basics, what they absolutely must do to get through.'

The language of the advice was also problematic:

'having looked at some of the material I have to say not a lot of it's very visual, it's a lot of written stuff and they use a lot of terminology which is not self-explanatory to business people '

Every property is different and the application of the guidance to specific cases is often unclear in the absence of specialist advice that would be expensive to obtain. For smaller businesses, some support would be necessary. Yet, the local authority no longer has sufficient staff resources to offer free advice, if indeed it ever had the necessary staff resources. Some businesses assume that property-level protection is not for them, either because they have not been previously flooded or because of subsequent flood prevention measures or because the property is apparently unsuitable. In the words of the Director of a small business flooded in 2007 and continuing in an unprotected area of the floodplain. 'There's not much we can do to be honest, it'll just be a case of cracking on and trying to clean it up'.

Discussion: the events in perspective

The published documentation and the comments of respondents suggest an open-ended, continuing process of risk management, much as is the assumption of socio-ecological theories. The direction of change has been towards resilience, in line with most accounts. The extent of change can be easily exaggerated, however, depending on the exact meaning of resilience. For example, of the seven groups of recommendations listed in the Pitt review, only two: 'speeding up recovery' and the provision of 'better advice and help' fall directly within the scope of 'resilience' understood in ecological terms opposition to resistance.

To say that the shift towards resilience is qualified is another way of saying that the promotion of resilience rather than resistance runs into a series of practical obstacles if taken too far. Yes, it is sensible to encourage residents, property owners and businesses to co-operate with one another and help themselves. However, the

consequences of flooding for business activities are so unpredictable and severe that owners and their managers want flood protection pure and simple. The damaging consequences of flooding are, moreover, compounded by the cost or impossibility of arranging business insurance in areas of higher flood risk.

The ecological definition of resilience, in opposition to resistance is not the only definition, however. Resilience may also be defined as a 'learning by doing process' (Liao 2012). On this definition, a partial shift towards resilience may again be identified. There was a learning phase immediately after the flooding event, stimulated in part by the CAMINO and MARE initiatives, by the enquiries associated with the Pitt report, by the establishment of a strategic flood management and planning process that persists to the present and by the institutional innovations associated with the establishment of the BID in Sheffield.

The various initiatives did not always realise their objectives. Transition, in the sense of a movement towards more sustainable building practices or adoption of an honest broker role has hardly started- mainly owing to a failure to provide encouragement or support for local measures, consistent with the findings of other case studies (Moloney and Horne 2015: Vandevyvere & Nevens 2015). Moreover, as became apparent in interview, there are doubts about whether learning, innovation and all the consultation that this involves can be maintained against a background of staffing cuts and restrictions.

The BID itself deserves special mention as the best example of a creative innovation, involving new institutional actors in flood management. The BID might suggest, moreover, that levying specific flood-oriented business taxes is a more practical policy than an emphasis on the promotion of property-level measures. The BID is not a spontaneous exercise in self-organisation, however, as might be suggested by community-based concepts of resilience. Its establishment presupposes the existence of a pre-existing legal framework that permits additional local taxation and, in addition, at the local level, a combination of local leadership amongst business groups; an acceptance of substantial public sector set-up costs (of a type that cannot be easily recovered); and finally the agreement of national funding agencies to cover the bulk of investment costs. As yet there are no reports of other BIDs being established for flood protection reasons in England.

The phronetic case study method, as suggested by Flyvbjerg (2004: 2006), begs the question as to the winners and losers. Amongst local organisations, the

Chambers of Commerce emerged as key actors especially in the immediate aftermath of the flood because they had the contacts and were in a good position to collect and distribute information. Appeals to economic regeneration and job protection, especially the protection of jobs associated with large businesses in the lower Don Valley in Sheffield, offered a powerful discourse for action. Business and especially the larger businesses have therefore emerged as the biggest winner. Though flood protection work is still continuing in the BID area, businesses located there will soon face a reduced risk of flooding. The focus on business properties may be defended by the additional contributions made by property owners through the BID, by the role of the BID area in providing employment for residents of a wide area and by the way that protection of businesses has also involved the protection of urban infrastructure. Not all businesses have been protected, however. As shown in Table 3 and Figure 3, especially in Rotherham, many mostly smaller businesses remain at risk of flooding, with all its costs and disruption.

The events of 2007 are sufficiently recent to be remembered in the interviews. Memory is important, moreover, in maintaining a sense of concern, as is a message of socio-cultural theory. Perceptions of events are invariably influenced by prior expectatations, however. The first measures taken in the BID were based directly on a belief that at least part of the problem has stemmed from a lack of publicly-funded river maintenance before 2007. Business interests were mobilised by the experience of flooding and, true to their preference for self-help, they blamed the neglect of public authorities for their predicament.

The personal and community memory of flooding events figure in a slightly different way in the case study of Pickering, by Whatmore (2013) where proposals for 'natural' water retention originated from citizen involvement. In Sheffield and Rotherham, in contrast, proposals for water retention emerged from technical analysis and, in their most recent formulation, in potential opposition to the views of residents. The relatively large size of the urban area and the involvement of business groups have led to a more hierarchical and 'gridded' response.

The opposition between local residents and technical analysis has been interpreted by Haughton (2015) as a product of place attachment and its associated emotions. Other related interpretations are that conflicts arise owing to different priorities about the use of space (Kati and Jari 2016) or to contrasting attitudes to nature, for example between conservationists and the demands of securitisation

(Davoudi 2014). Emotions in planning and environmental policy are, of course, not just confined to place attachment. The experience of flooding and the threat to jobs is also an emotional issue, but this only serves to intensify the potential for conflict.

In this context, if local groups are to have an effective voice, they will almost certainly need some form of technical support to allow the investigation of alternative methods of retaining flood water in places where it can do less damage. The use of amenity areas for water storage is controversial, but relatively simple in conception and simple in relation to the range of stakeholders. Other methods raise a multiplicity of issues and these go beyond the legal rigidities associated with property (Tempels and Hartmann, 2014). In some cases, such as the opening up culverted streams, the pattern of legal rights and obligations may indeed prove complex and disputed. Otherwise, the main obstacles derive from the use of property, rather than its legal character- the interests and expectations of owners and businesses, including agricultural owners; the costs of relocating economic activities; and, in the case of the reservoirs owned by Yorkshire Water, the cost of resolving the conflicting priorities of secure clean water supply and flood protection. These very complexities suggest the need for a wider debate about policy options despite the time and staffing costs previously noted as a disadvantage of public consultation exercises (for example by Menzel & Buchecker 2013).

In Rotherham and Sheffield, issues of close administrative coordination have proved less important in the narrative of flood risk management than in the account of Hull by Coulthard and Frostick (2010). Hull is low lying and surface drainage is dependent on pumping stations that are owned by Yorkshire Water. As the comparison suggests, the material character of flood risk remains significant in determining the detailed administrative and policy arrangements.

Conclusions

Consideration of both theory and the case study require a clarification of the relation between theory and practice. Adaptive management and transition management both highlight risk management as a continuous and wide ranging exercise rather a series of disconnected engineering projects. Both involve social learning and therefore have value as normative theories that provide criteria of good

and bad practice. Both approaches, for example, highlight the blockages to learning, as these have arisen in the case study area.

- the staffing costs involved in innovation and consultation;
- the difficulties of reaching and communicating with small businesses so as to encourage property-level measures;
- the lack of national support for transition measures; and
- the complexity of dealing with a multiplicity of stakeholders and landowners with particular interests.

Nevertheless, confusions arise when adaptive management is conflated simply with 'resilience', used without a precise definition. It is confusing, to use ecological concepts of 'resilience' so as to exclude any engineering works whatsoever. The conditions in Sheffield with existing heavily engineered watercourses and employment already concentrated on a floodplain amply demonstrates exactly how resilience and resistance, including engineering works, may co-exist with one another. Confusion is compounded, moreover, by a lack of political transparency. Understandings of resilience as process involve or imply a series of desirable attributes, responsiveness, effectiveness etc. Yet the policy discourse on resilience has also amounted to a tendency for the state to shift funding responsibility towards individuals, firms and businesses. That is exactly the implications of the BID in Sheffield and the property-level toolkits in Rotherham. Any such shift in responsibility will not necessarily be welcomed by those affected. For these reasons, policy and practice rests on an ambiguous and shifting balance between resistance and resilience.

Politics and, as socio-cultural theory suggests, political culture are therefore crucial to events. Different styles of action involve different institutional arrangements, notably about the extent of individual and collective responsibility. Measures are, likely to reflect in part the campaigns of amenity and environmental groups in promoting oppositional, critical 'green' policies and solutions. Finally, learning is grounded in memory, so suggesting a need to maintain a collective, public memory of the 2007 event, even as personal memories fade.

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Table 1: Applying socio-cultural theory to environmental risk management		
Style of action (Douglas 1999: Douglas and Wildavsky 1982)	Implications for social organisation (Douglas and Wildavsky: Tansey 2004, 26)	Social assumptions of risk management
High grid/ high group	<i>hierarchy and bureaucracy</i>	<i>as a controlled environment</i>
Low grid/ high group	<i>egalitarianism and community</i>	<i>as mutual aid</i>
Low grid/ low group	<i>the market and self-help</i>	<i>as individual adaptation and initiative</i>
High grid/ low group	<i>isolation and fatalism</i>	<i>as an acceptance of the inevitable</i>

Table 2: Frameworks for the analysis of environmental risk management			
Name of framework	Adaptive management:	Transition management:	Expectation management
Theoretical background	Socio-ecological systems	Technological innovation theory	Socio-cultural processes
Ontological assumptions	Impersonal, ecological systems-rainfall, water flows, habitats etc: Panarchy:	Coupled social and technical systems: networks and interactions between actors	The interaction between personal experience and social order
Realm of application	Generally spatial (natural parks, river basins,..)	Sectors of the economy or government.	The type and strength of social order
Drivers of change	Evolution of complex, ever-changing and relatively unstable systems	Multi-level pathways intended to unlock systems of technology, production and consumption	The conflict between the centre and peripheral groups.
Overall aim as applied to policy	Promoting resilience: managing and reducing risk in an uncertain, not fully predictable context:	Moving practice in the direction of sustainability: reducing long-term risks	Resolving and recognising the claims and perspectives of different groups
Management style	Self-organisation: social learning: actions are designed as experiments at varied spatial scales.	Planned co-evolution with providers and industry: multi-level learning, including experimental, local 'niches'.	'Clumsy' policy making, involving multiple rationalities and multiple groups.
Treatment of politics	A broad consensus generated at a local or regional level	Targets and policies set as part of the context	A shifting process determined by of a variable political culture.
Adapted, in part, from: Foxon et al 2009: Voß and Bornemann. 2011.			

Table 3: At risk properties in Sheffield and Rotherham				
	Sheffield		Rotherham	
Annual Flood risk	Residential	Non-residential	Residential	Non-residential
High: more than 1 in 30 (>3.3%)	217	173	29	190
Medium: between 1 in 30 (3.3%) and 1 in 100 (1%)	3,042	709	182	318
Low: between 1 in 100 (1%) and 1 in 1000 (0.1%).	3,795	1,878	323	445
Total	7,054	2,760	534	953
Source: CDRC 2015 RoFRS Geodata Pack by the ESRC Consumer Data Research Centre; Contains National Statistics data Crown copyright and database right 2015; Contains Environmental Agency data copyright 2015 (under Open Government Licence)				

Figure 1: The River Don in Sheffield

March 2017



Figure 2
The extent of flood risk in Rotherham and Sheffield

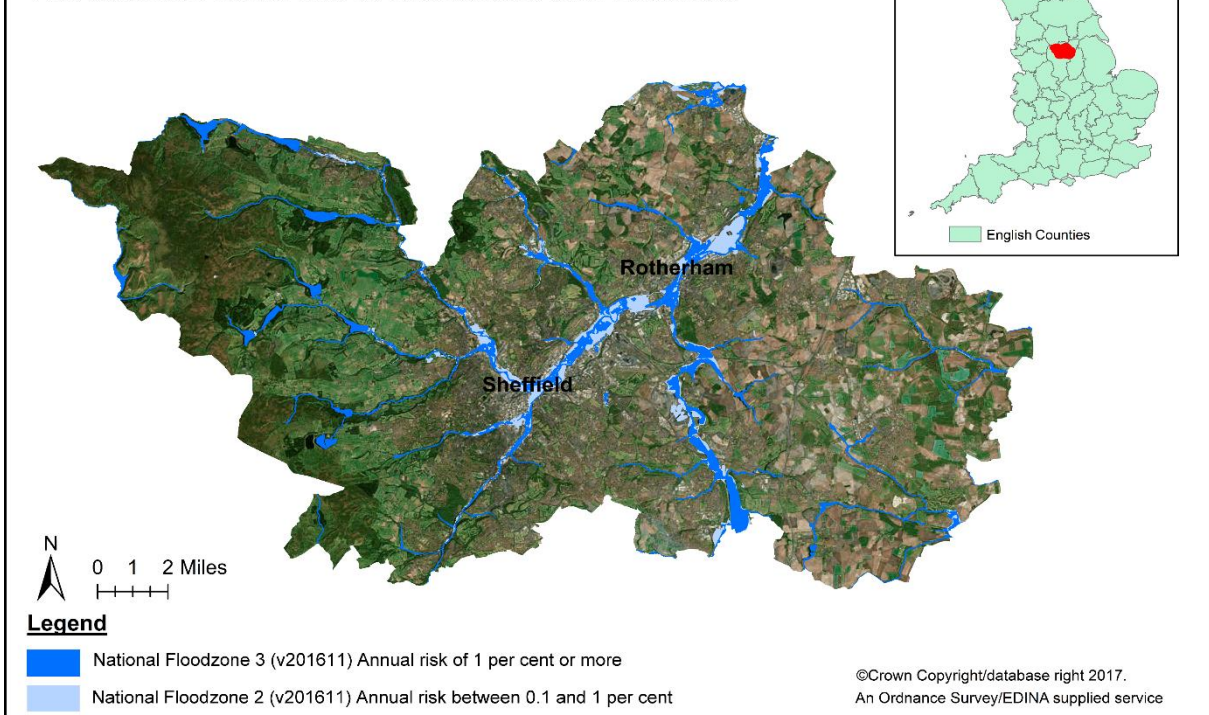


Figure 3
A diagrammatic distribution of high risk non-residential properties

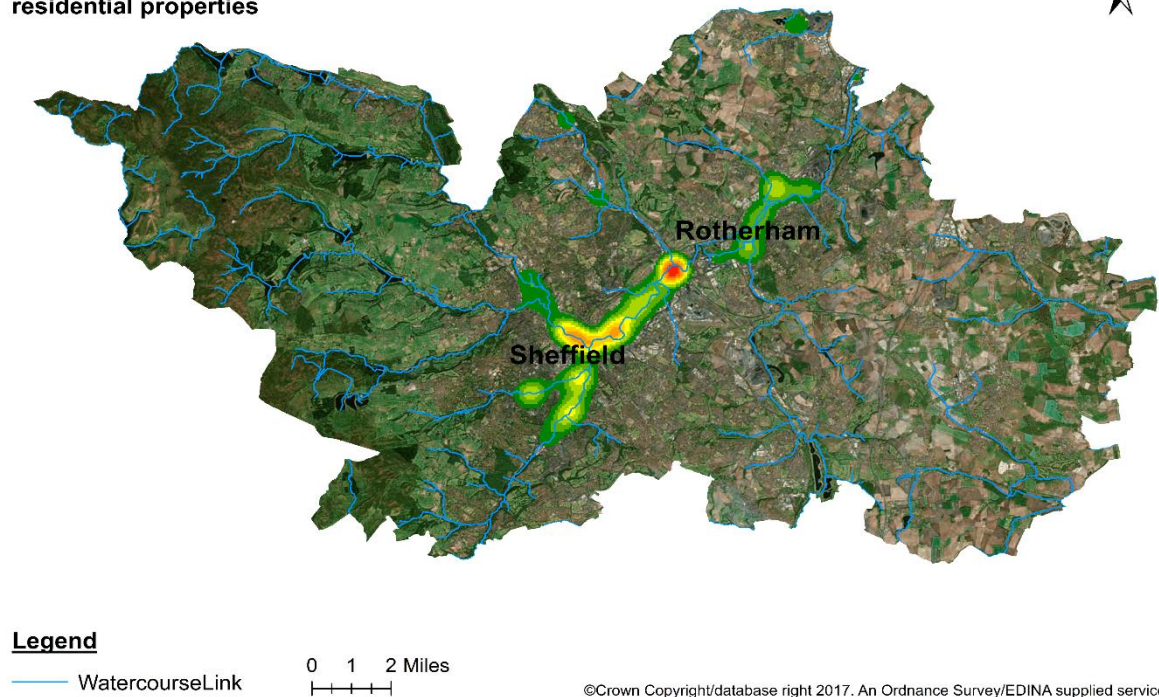


Figure 4: The Nursery Street 'Pocket Park'

